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abandoned; for the microbes, which are the agents of putrefaction, survive the exposure.

Some of the experiments on which this conclusion rests are briefly described. Meat in tins, exposed to -63°C . for six hours, underwent (after thawing) putrefaction with generation of gases. Trials with fresh urine showed that freezing at very low temperatures delayed the appearance of the alkaline fermentation, but a temperature of -63°C . for eight hours did not sterilize the urine. Samples of fresh milk exposed to temperatures of from zero to -80°F . for eight hours, curdled, and showed the well-known *Bacterium lactis*; and, so far as could be observed, freezing did not delay the process after the flasks were kept at a temperature of about 50°F . Similar results were obtained with ale, meat-juice, vegetable infusions, etc.

It is probable that the micro-organisms were frozen solid. One cannot suppose that in these circumstances any of the phenomena of life take place: the mechanism is simply arrested, and vital changes resume their course, when the condition of a suitable temperature is restored. These considerations led the authors to examine whether any of the vital phenomena of higher animals might be retained at such low temperatures. They ascertained that a live frog may be frozen through quite solid in about half an hour at a temperature of -20°F . to -30° . On thawing slowly, in two instances the animal completely recovered. After longer exposure the animals did not recover. In two cases frogs were kept in an atmosphere of -100°F . for twenty minutes, and although they did not revive, yet, after thawing out, their muscles still responded feebly to electrical stimulation. One experiment was performed on a warm-blooded animal, — a rabbit. The cold-blooded frog became as hard as a stone in from ten to twenty minutes, but the rabbit produced in itself so much heat as enabled it to remain soft and comparatively warm during an hour's exposure to -100°F . Still its production of heat was unequal to make good the loss; and every instant it was losing ground, until, at the end of the hour, its bodily temperature had fallen about 56°F . below the normal, but was still 143°F . above the surrounding temperature. When taken out, the animal was comatose, and reflex action was abolished. Placed in a warm room, its temperature rose rapidly, and the rabbit completely recovered.

The observations are of great value, and highly suggestive. Those upon the rabbit indicate that death from cold is preceded by loss of consciousness, owing to the early suppression of the activity of the gray matter of the encephalon. This confirms the belief that death by freezing is comparatively painless. The viability of microbes at low temperatures has also been demonstrated by Pictet and Yung,¹ who found that various bacilli can survive -70°C . for a hundred and nine hours. After such exposure, *Bacillus anthracis* retained its virulence when injected into a living animal.

We cannot refrain from asking, Are not frozen micro-organisms the means of disseminating life

through the universe? An affirmative answer is at least a better hypothesis than the assumption of spontaneous generation to account for the origin of life on the earth. May not life be coeval with energy? May it not have always existed?

CHARLES S. MINOT.

PREHISTORIC AMERICAN SCULPTURES.

AMONG the many interesting sculptures in stone of the prehistoric Americans are those found in



HUMAN SACRIFICE. BAS-RELIEF AT SANTA LUCIA COSUMALHUPA. (*La Nature*.)

Guatemala, which were first described by Dr. Habel in No. 269 of Smithsonian contributions to knowledge, 1879. These were principally fallen monoliths which were discovered in 1862, near the village of Santa Lucia Cosumalhupa, near the base of the Volcano del Fuego. Several of these carvings were afterwards secured by Dr. Bastian for the Berlin museum. The majority of those figured by Dr. Ha-

¹ *Comptes rendus*, Paris, xcviij. 747.

bel are in cavo-relievo, similar to many of the Assyrian sculptures. Most of these carvings represent sacrifice and adoration. Dr. Habel considers that they represent a period of culture when the people were passing from the worship of the sun and other heavenly bodies to that of man, or the beginning of anthropomorphism. One of these monoliths, which is a stone twelve feet high, three feet wide, and two feet thick, is reproduced in the accompanying figure. It is supposed to represent a priest offering the sacrifice of a human being. He holds the head in his left hand, and in his right is the knife with which he has severed the head from the body upon which he stands. At the lower part of the stone two attendant figures are represented, each carrying a human head. One of these smaller figures has a skull for a head, and is supposed to symbolize death. This figure also occurs on other of these carved stones. The elaborate ornamentation of the naked body of the priest is characteristic of all the figures given by Habel. In this instance the head-dress is in the form of a crab, and the hair is arranged in a sort of queue, with many decorations appended. The ear has a small ring in the lobe, from which hangs a larger ring. Around the neck is a cord and tassel, and about the waist is an elaborate girdle having at the back the head of an animal. Just below the right knee there is a garter. This occurs on all similar figures. The left foot is protected by a sandal. In some of the other figures both feet have sandals, and in one both are naked. The curved figures above the right hand of the priest, and below the body of the victim, are supposed to represent speech, as they occur with various modifications in several other carvings. In connection with these singular Central-American works of art, it is of interest to recall the carved shells found in mounds in the United States, and recently figured by Mr. Holmes in the report of the Bureau of ethnology, as the expression of ideas in a similar manner suggests a common origin.

THE PROPOSED CHANGE IN THE ASTRONOMICAL DAY.

Two eminent astronomers have recently given their views on the proposed change of the astronomical day, and both are inclined to favor the change. This discussion, which is of particular interest to astronomers, is on the sixth resolution of the Prime-meridian conference of Washington, — “that the conference expresses the hope, that, as soon as may be practicable, the astronomical and nautical days will be arranged everywhere to begin at mean midnight.” The present custom, as we know, is for the astronomer to begin his day at noon of the civil day; and we are glad to find given at some length the opinions of such authorities as Struve and Oppolzer.

Professor Struve, director of the Pulkowa observatory, in a pamphlet¹ of twenty-seven pages, gives a very interesting account of the causes which led to

the international conference, and the results which it reached. In regard to the change in the beginning of the astronomical day, he thinks that the question before astronomers is not only of giving up a long-established custom, with consequent changes of rules of many years' standing, but it also involves a serious interruption of astronomical chronology. Without a doubt, the astronomer would have to make a decided sacrifice in conforming to the wish of the conference; but, after all, this sacrifice is no greater than our forefathers made when they changed from the Julian to the Gregorian calendar, — a sacrifice to convenience of which we are still made sensible whenever we have occasion to go back to early observations.

We need have little hesitation in making a similar sacrifice, if it will prevent discordance between the civil and scientific custom of reckoning time, particularly troublesome where astronomical establishments come in contact with the outer world.

Professor Struve states that the Pulkowa observatory is prepared to adopt the new time, the only question being as to the epoch when the change should be introduced in the publications of the observatory. He is inclined to recommend that this should be deferred until some agreement can be reached by astronomers, and until the new time is adopted in the Ephemerides. This might be for the year 1890, or perhaps, better still, at the beginning of the next century.

Professor Oppolzer has contributed a paper on the proposed change of the astronomical day to the March number of the *Monthly notices of the Royal astronomical society* (vol. xlv. pp. 296-298). He says, “When once such a universal time is introduced for all purposes, it is quite natural that the question must arise, if there is indeed so great a necessity to retain in astronomy, and only in astronomy, a different reckoning of time. I fail to see this necessity, and I do not think that it would cause any serious trouble or confusion if a change were to be made in our astronomical reckoning; whilst a special mode of reckoning time in one science only, when all others use the generally adopted standard, will, without doubt, be a source of error and confusion.” He then takes up in some detail the objections urged against the proposed change by Professor Newcomb in a previous communication to the same publication (vol. xlv. pp. 122, 123), and he discusses the changes which would be necessary in the Ephemerides. Professor Oppolzer proposes to give practical effect to his views by adopting the new reckoning of time in an extensive list of eight thousand solar, and fifty-two hundred lunar, eclipses which he is now preparing for publication.

It is difficult to see how this matter will finally be decided. It is evidently a question for astronomers to settle among themselves; but so far they seem to be very evenly divided. For instance: out of some twenty-seven astronomers whose opinions, more or less decided, have been accessible for a count, thirteen seem inclined to favor the proposed change, while fourteen are opposed to it. And among

¹ Die beschlüsse der Washingtoner meridianconferenz. St. Petersburg, 1885. 27 p. 8°.